POWERTECH (USA) INC.

Powertech (USA) Inc.
Dewey-Burdock Project
Class III Underground Injection Control Permit Application

December 2008
Revised July 2012
Updated January 2013

Prepared for

U.S. EPA Region 8
1595 Wynkoop Street
Denver, CO 80202-1129
Phone: 800-227-8917

Prepared by

Powertech (USA) Inc.
5575 DTC Parkway, Suite 140
Greenwood Village, CO 80111
Phone: 303-790-7528
Fax: 303-790-3885

TABLE OF CONTENTS (Continued)

11.0 ATTACHMENT M - CONSTRUCTION DETAILS

This attachment details the construction procedures that will be utilized for injection, production and monitor wells at the Dewey-Burdock Project. All injection and production wells will be completed in accordance with South Dakota well construction standards and EPA standards for Class III UIC wells.

11.1 Well Construction Materials

Well casing material typically will be thermoplastic such as polyvinyl chloride (PVC) with at least SDR 17 wall thickness. The wells typically will be 4.5 to 6-inch nominal diameter and will meet or exceed the specifications of ASTM Standard F480 and NSF Standard 14. In order to provide an adequate annular seal, the drill hole diameter will be at least 2 inches larger than the outside diameter of the well casing.

The annulus will be pressure-grouted and sealed with neat cement grout composed of sulfate-resistant Portland cement in accordance with South Dakota wells construction standards. Water used to make the cement grout will not contain oil or other organic material. Cement grout could contain adequate bentonite to maintain the cement in suspension in accordance with Halliburton cement tables.

Casing will be joined using methods recommended by the casing manufacturer. PVC casing joints approximately 20 feet apart will be joined mechanically (with a watertight O-ring seal and a high strength nylon spline) to ensure watertight joints above the perforations or screens. Casings and annular material will be routinely inspected and maintained throughout the operating life of the wells.

11.1.1 Thermoplastic Well Casing Variance Request

Powertech requests a variance from the requirement in 40 CFR § 147.2104(b)(1) that plastic well casing materials, including PVC, ABS or others, not be used in new injection wells deeper than 500 feet in the State of South Dakota. This variance is requested on the following basis:

1. Collapse pressure calculations and well casing manufacturer specifications indicate that PVC well casing can be used at depths greater than 500 feet considering the site-specific well construction methods (see Section 11.1.1.1).
2. PVC well casing has been used successfully for wells deeper than 500 feet at uranium ISR facilities for many years (see Section 11.1.1.2).
3. PVC well casing is commonly used for other wells in South Dakota deeper than 500 feet (see Section 11.1.1.3).
4. Thermoplastic well casing is the preferred well casing material for ISR facilities due to corrosion resistance. The corrosion resistance of PVC compared to carbon steel well casing is well documented.

5. Each new injection, production and monitor well will be pressure tested to confirm the integrity of the casing prior to being used for ISR operations. MIT will be repeated every 5 years and after any repair where a downhole drill bit or under-reaming tool is used (see Section 11.5).
6. The injection pressure for each injection well will be maintained below the maximum pressure rating of the well casing (see Section 7.2).
7. An extensive excursion monitoring program will be implemented by installing and sampling monitor wells in the perimeter of the production zone and in overlying and underlying hydrogeologic units to detect potential excursions of ISR solutions into USDWs such as would occur with a leaking injection well (see Section 14.2).
8. Injection pressures will be monitored through automated control and data recording systems that will include alarms and automatic controls to detect and control a potential release such as would occur through an injection well casing failure (see Section 14.1).

The variance is requested pursuant to 40 CFR § 147.2104(d)(4), which states that the Regional Administrator may approve alternate casing provided that the owner or operator demonstrates that such practices will adequately protect USDWs.

11.1.1.1 Hydraulic Collapse Pressure Calculations

When specifying well casing and installation, Powertech will adhere to the requirements in ASTM F480, Standard Specifications for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80. ASTM F480 requires that "the depth at which thermoplastic well casing can be used is a design judgment." There is no depth of installation limit in ASTM F480 except that PVC well casing should be "used under conditions that meet manufacturer's recommendations for its type" and that "the driller shall install the thermoplastic casing in a manner that does not exceed the casing hydraulic collapse resistance." In accordance with these requirements, Powertech will ensure that all thermoplastic well casing meets the manufacturer's recommendations for its type and is installed in a manner that does not exceed the hydraulic collapse resistance.

The net hydrostatic pressure on the well casing is calculated as the difference between the exterior and interior hydrostatic pressure. The hydrostatic pressure is calculated as the fluid density multiplied by the fluid depth. Powertech will use cement to grout the annulus on all injection, production and monitor wells. Using a typical cement grout density of 90 lb/ft^3, and recognizing that the inside of the well casing will always be full of water before the cement cures (with a density of at least 62.4 lb/ft^3 depending on whether additives are used), the pressure versus depth gradient will be about 27.6 lb/ft^3 or about 0.2 psi/ft of depth. According to CertainTeed (2011), the hydraulic collapse pressure for SDR 17 PVC well casing is about 224 psi. Therefore, it would take an installation depth much greater than 1,000 ft to exceed this pressure as long as cement grout were used and the well casing remains full until the cement hardens. Both of these conditions will be met in all injection, production and monitor well casing installations using the installation procedures described in Section 11.2. Water will be used to displace the cement and force it upward into the annulus; therefore, the well casing will always be full of water while the cement cures.

When designing and installing injection, production and monitor wells, Powertech will adhere to the requirements of ASTM F480 and manufacturer's criteria to ensure that the installation does not exceed the casing hydraulic collapse resistance.

11.1.1.2 Use of PVC Well Casing at Other ISR Facilities

There are numerous successful applications of PVC well casing at uranium ISR projects where the well depths are in excess of 500 feet. For example, at the Crow Butte project, where the average ore depth is 650 feet, 4.5-inch ID PVC well casing has been successfully used for many years (IAEA, 1994). There are also numerous Wyoming examples, including Irigaray/Christensen Ranch, where PVC well casing is routinely used at depths greater than 500 feet. According to COGEMA (2008b), SDR 17 PVC well casing is used for injection wells at Irigaray and Christensen, where the average depth of the ore zone in some mine units is between 500 and 600 feet.

11.1.1.3 South Dakota Well Construction Standards

South Dakota has tolled DENR administrative rules on UIC Class III wells and ISR until the department obtains primary enforcement authority. Therefore, South Dakota does not directly regulate well casing materials for injection, production and monitor wells. However, general South Dakota well construction standards in ARSD 74:02:04 allow the use of PVC well casing for other types of wells to depths greater than 500 feet. For example, Section 36 of ARSD 74:02:04 provides construction requirements for SCH 80 PVC private domestic and non-commercial livestock wells more than 1,000 feet deep.

ARSD 74:02:04, Sections 42 and 43 discuss general well casing requirements. Section 42 says, "Casing materials may be thermoplastic, steel, nonferrous metal, fiberglass, precast curbing, or concrete" but that, "Casing may only be used under conditions that meet manufacturer's recommendations and specifications for its type." Section 43 provides thermoplastic casing requirements, including that PVC well casing 5 inches or greater in diameter must have a minimum wall thickness of 0.250 inch. Powertech will ensure that all PVC well casing 5 inches or greater in diameter has a minimum wall thickness of 0.250 inch. This means that 5-inch PVC well casing will be SCH 40 or heavier or SDR 17 or heavier. Section 43 also requires thermoplastic pipe to conform to ASTM F480. Compliance with the requirements in ASTM F480 is described in Section 11.1.1.1.

11.1.2 Compliance with 40 CFR § 147.2104(d)

The injection wells will comply with the following 40 CFR § 147.2104(d) regulations for protection of USDWs in South Dakota:

(1)(i) Setting surface casing 50 feet below the lowermost USDW: The Fall River Formation and Chilson are the shallowest aquifers potentially classified as USDWs in the project area. Since the portion of the Fall River and Chilson within the well fields will be in an exempted aquifer and since injection wells will not target aquifers deeper than the Fall River or Chilson, there will not typically be any USDWs between the ground surface and the total injection well depth. Should saturated alluvium be present, surface casing will be installed through the alluvium regardless of whether it would be classified as a USDW.

(1)(ii) Cementing surface casing by recirculating the cement to the surface from a point 50 feet below the lowermost USDW (see above); or

(1)(iii) Isolating all USDWs by placing cement between the outermost casing and the well bore: The annular seal will be pressure grouted with neat cement grout as described above.

(2) Isolate any injection zones by placing sufficient cement to fill the calculated space between the casing and the well bore to a point 250 feet above the injection zone: The entire annular seal will be pressure grouted with neat cement as described above.

In addition, Powertech will comply with the 40 CFR § 147.2104(d)(3) requirements for cement, including using cement (i) of sufficient quantity and quality to withstand the maximum operating pressure; (ii) which is resistant to deterioration from formation and injection fluids; and (iii) in a quantity no less than 120% of the calculated volume necessary to cement off a zone.

11.2 Well Construction Methods

Typical production and injection well installation will begin by drilling a pilot bore hole through the ore zone to obtain a measurement of the uranium grade and thickness. The ore depth is anticipated to range from 200 to 800 feet. Typical monitor well construction will begin with drilling a pilot bore hole through the target completion zone. For all wells, the pilot bore hole will be geologically and geophysically logged. After logging, the pilot bore hole will be reamed to the appropriate diameter to the top of the target completion zone. A continuous string of PVC casing will be placed into the reamed borehole. Casing centralizers will be installed as appropriate. With the casing in place a cement/bentonite grout will be pumped into the casing. The grout will circulate out the bottom of the casing and back up the casing annulus to the ground surface. The volume of grout necessary to cement the annulus will be calculated from the bore hole diameter of the casing with sufficient additional allowance to achieve grout returning to surface. Grout remaining inside the well casing may be displaced by water or heavy drill mud to minimize the column of the grout plug remaining inside the casing. Care will be taken to assure that a grout plug remains inside the casing at completion. The casing and grout then will be allowed to set undisturbed for a minimum of 24 hours. When the grout has set, if the annular seal observed from the ground surface has settled below the ground surface, additional grout will be placed into the annular space to bring the grout seal to the ground surface.

After the 24-hour (minimum) setup period, a drill rig will be mobilized to finish well construction by drilling through the grout plug and through the target completion zone to the specified total well depth. The open borehole will then be underreamed to a larger diameter. Figure 11.1 depicts the typical well construction. Figures 11.2 and 11.3 depict the typical injection and production well heads, respectively. Figure 11.1 and the following discussion represent the anticipated typical injection well construction methods. The actual methods may vary.

A well screen assembly (if used) will be lowered through the casing into the open hole. The top of the well screen assembly will be positioned inside the well casing and centralized and sealed inside the casing using K packers. With the drill pipe attached to the well screen, a 1-inch diameter tremie pipe will be inserted through drill pipe and screen and through the sand trap check valves at the bottom of well screen assembly. Filter sand (if used), composed of well-rounded silica sand sized to optimize hydraulic communication between the target zone and well screen, then will be placed between the well screen and the formation. The volume of sand introduced will be calculated such that it fills the annular space. The sand will not extend upward beyond the K packers due to packer design. A well completion report then will be prepared for each well.

11.3 Geophysical Logging

Ore grade gamma log, self potential and single point resistivity electric logs will be run in the pilot holes prior to reaming the hole to final diameter to run casing. These logs will determine the location and grade of uranium and the sand and clay unit depths to properly plan each pattern.

11.4 Well Development

The primary goals of well development will be to allow formation water to enter the well screen, flush out drilling fluids, and remove the finer clays and silts to maximize flow from the formation through the well screen. This process is necessary to allow representative samples of groundwater to be collected, if applicable, and to ensure efficient injection and production operations. Wells will be developed immediately after construction using air lifting, swabbing, pumping or other accepted development techniques which will remove water and drilling fluids

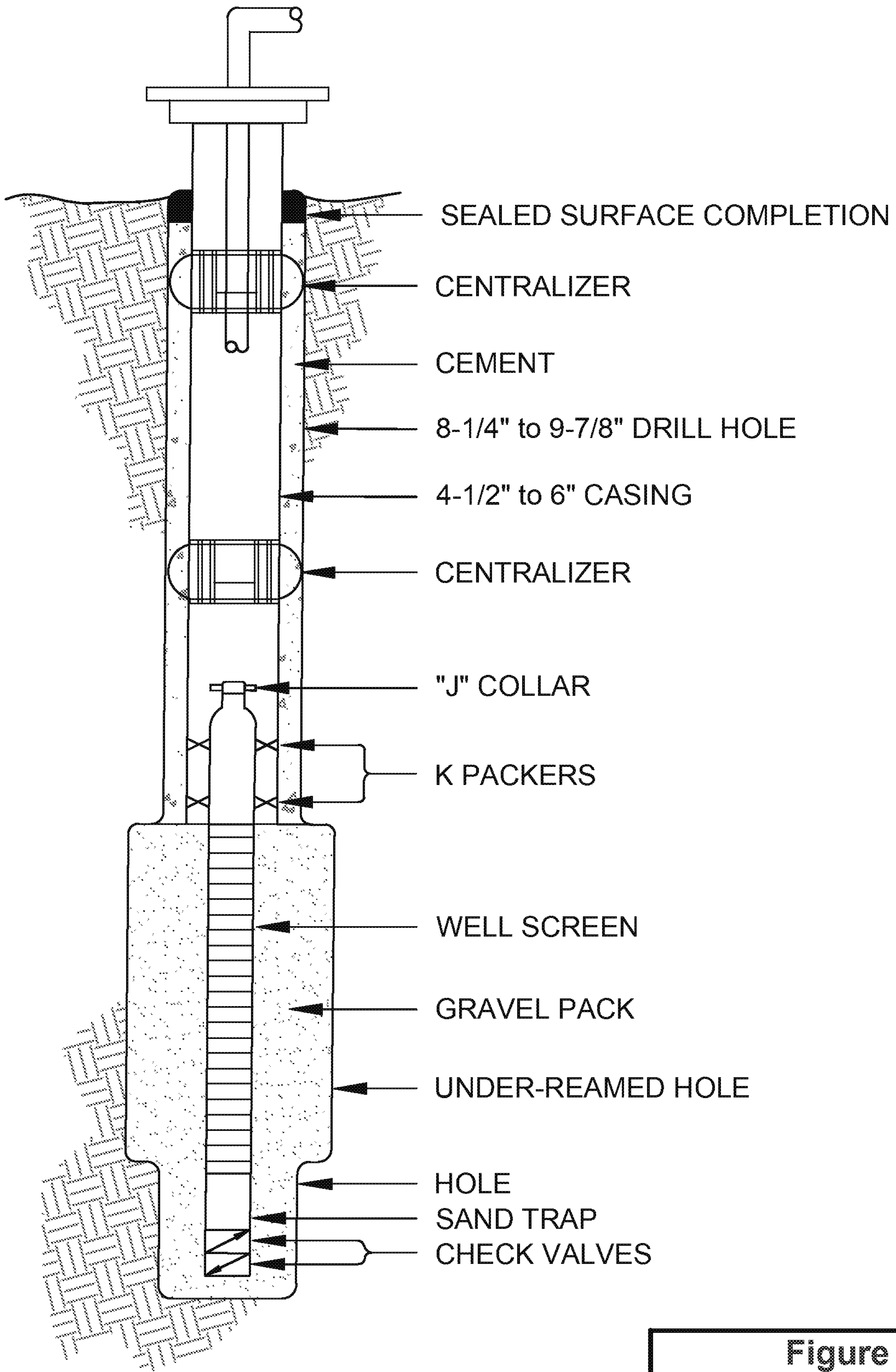

Figure 11.1

Typical Well Construction

Dewey-Burdock Project

DRAWN BY L. Tafoya	POWERTECH (USA) INC.
DATE 24-Jul-2012	
FILENAME Wells-TypConstruction.dwg	

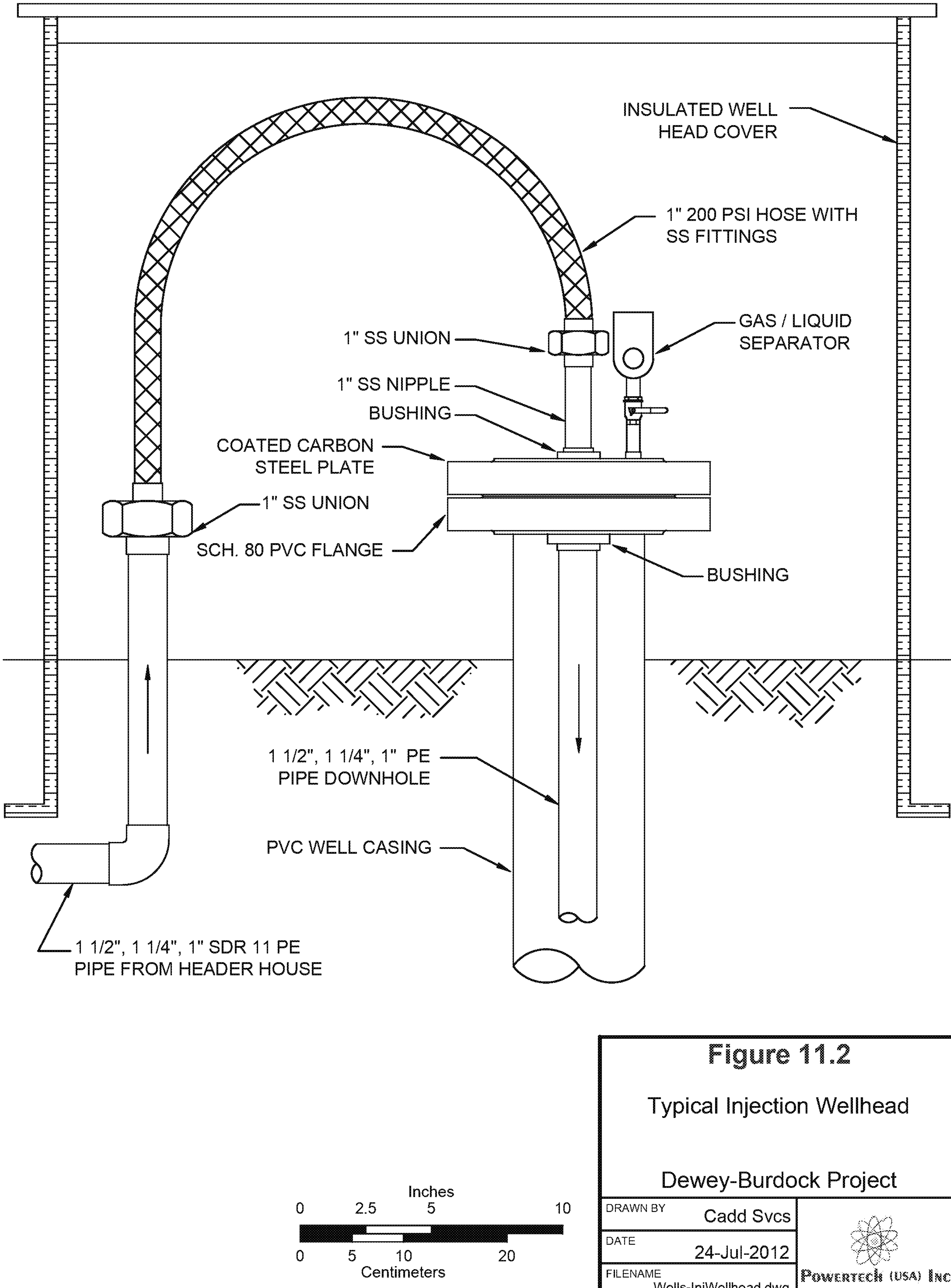

Figure 11.2

Typical Injection Wellhead

Dewey-Burdock Project

DRAWN BY	Cadd Svcs
DATE	24-Jul-2012
FILENAME	Wells-InjWellhead.dwg

POWERTECH (USA) INC.

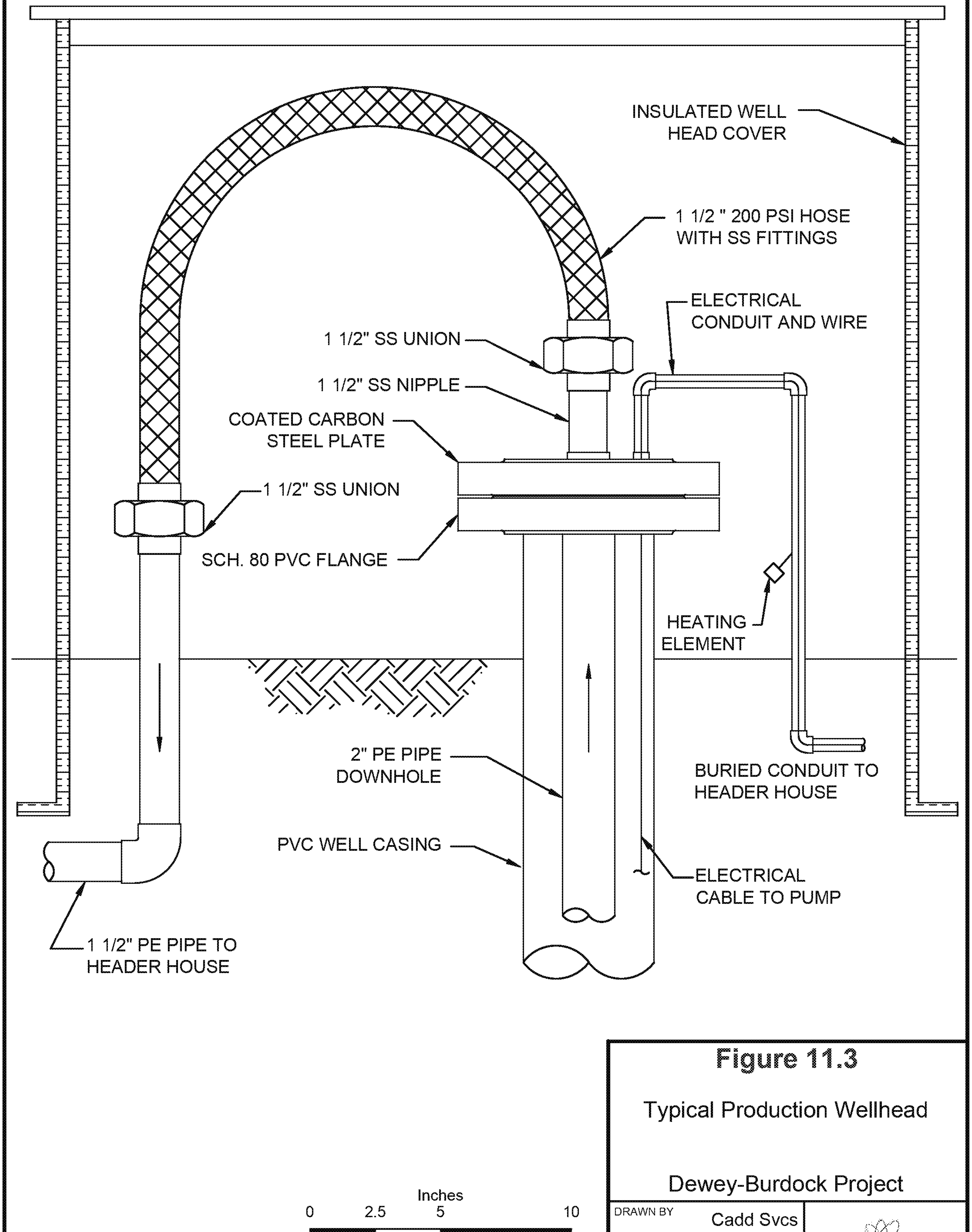

Figure 11.3

Typical Production Wellhead

Dewey-Burdock Project

DRAWN BY Cadd Svcs	POWERTECH (USA) INC.
DATE 24-Jul-2012	
FILENAME Wells-ProdWellhead.dwg	